IN COOPERATION WITH:

PROCEEDING

1ST PIKSI INTERNATIONAL CONFERENCE ON KNOWLEDGE AND SCIENCES 2014 (1ST PICKS 2014)

SABUGA ITB, 18-19 NOVEMBER 2014

"Enforcing Sustainable Development Towards a Characterized and Global Competitiveness Nation through Various Aspects of Knowledge and Sciences"

POLITEKNIK PIKSI GANESHA

Jl. Jend. Gatot Subroto 301 Bandung 40274

Telp. (62)(22) 87340030 Fax. (62)(22) 87340086

www.piksi-ganesha-online.ac.id; email: piksionline@yahoo.com

www.scientific-journals.net; email: info@scientific-journals.net

BOARDS OF COMMITTEE

1ST PICKS

SECRETARIATE

POLITEKNIK PIKSI GANESHA

Jl. Jend. Gatot Subroto 301 Bandung 40274
Telp. (62)(22) 87340030 Fax. (62)(22) 87340086
www.scientific-journals.net; email: info@scientific-journals.net

IN COOPERATION WITH

54	Yudhi Yanuar	Piksi Ganesha Polytechnic Bandung	ENTERPRISE ARCHITECTURE PLANNING MANAGEMENT BUSINESS ENTERPRISE USING THE UNIFIED PROCESS (EUP)(CASE STUDY: SANG SURYA CENTER BANDUNG)	54
55	Asye Rachmawaty; Rita Komalasari	LP3I Polytechnic Bandung	THE INFLUENCE OF INFORMATION TECHNOLOGY UTILIZATION ON TEACHERS PERFORMANCE IN SMP NEGERI 43 BANDUNG	55
56	Ahmad Aftas Bin Azman; Mohd Zin Hassan; Nur Afiqah Binti Mohaini	Sultan Salahuddin Abdul Aziz Shah Polytechnic	GLASS WATER LIMIT DETECTOR FOR BLIND PEOPLE	56
57	Rini Tisnawati, Rr. Isni Anisah	Piksi Ganesha Polytechnic Bandung	IMPLEMENTATION LDR LIGHT SENSOR FOR HOME SECURITY USING LASER	57
58	Rida Hudaya; Cucun Wida Nurhaeti	Bandung State Polytechnic	APPLICATION OF ROW INDEX DATA ACCESS MATRIX ALGORITHM IN HMI/SCADA SYSTEMS	58
59	Septi Noer Lailela	Piksi Ganesha Polytechnic Bandung	INFLUENCE OF THE USE OF INFORMATION SYSTEMS AND ORGANIZATIONAL CULTURE, AGAINST EMPLOYEE PERFORMANCE IN PT. LEN INDUSTRI (PERSERO)	59
60	Achmad Faiz Bazar; Moh. Aries Syufagi	STMIK Yadika Bangil	THE IMPLEMENTATION OF A METHOD DESIGN SYSTEM OF FINITE STATE MACHINE (FSM) AND FLOWCHART FOR GAME "DAKON"	60
61	Dewi Handayani Untari Ningsih; Saefurrohman; Dwi Budi Santoso	Stikubank University	IMPLEMENTATION CULTURAL EHERITAGE SEMARANG USING WEB GIS IN THE CLOUD	61
62	Ricky Firmansyah	Bina Sarana Informatika	DEVELOPING ONLINE EXAMS USING GOOGLE DRIVE AS IMPLEMENTATION OF CLOUD COMPUTING TECHNOLOGY	62
63	Risa Farrid Christianti; Andika Agung; Eka Wahyudi	High School Of Telkom Telematics Technology	DESIGN OF ELECTRICAL EQUIPMENTS CONTROL USING WEB SERVER AND RASPBERRY PI IN HIGH SCHOOL OF TELKOM TELEMATICS TECHNOLOGY	63
64	Agustin Rozalena	Piksi Ganesha Polytechnic Bandung	THE PATTERN OF INTEGRATED CITY BRAND COMMUNICATION	64
65	Muslim and Suarga	Universitas Muslim Indonesia and STMIK Dipanegara	A HYBRID-MD HASH FUNCTION ALGORITHM TO IMPROVE COLLISION RESISTANCE OF THE MD5	65
66	Edi Suharto	Piksi Ganesha Polytechnic Bandung	DESIGN MODEL G2G (GOVERNMENT TO GOVERNMENT) CASE STUDY : INVENTORY SYSTEM OF GOVERNMENT PROPERTY OF WEST JAVA	66

DESIGN OF ELECTRICAL EQUIPMENTS CONTROL USING WEB SERVER AND RASPBERRY PI IN HIGH SCHOOL OF TELKOM TELEMATICS TECHNOLOGY

by:
Risa Farrid Christianti; Andika Agung; Eka Wahyudi
risa@st3telkom.ac.id; agung.leo22@gmail.com; ekawahyudi@st3telkom.ac.id
High School of Telkom Telematics Technology

ABSTRACT

The purpose of writing this paper is to find the solution how to control the use of electrical equipments daily, particularly in campus building, which so far is still done manually, which is spending much time and inefficient, using the Raspberry Pi (one of microcontroller types) that functions as the central of control and monitoring of electrical equipments in the Telkom's Telematics School of Engineering University, within one Single Board Computer. Raspberry Pi is one of microcontroller type that has many functions, one of them is as a web server. By using the GPIO (General Purpose Input Output) on the Raspberry Pi, every electrical equipment can be controlled and monitored, by means of communicating between electrical equipments with Raspberry Pi via TCP/IP and HTTP. Moreover used relays that serve as an electronic switch that will turn on or turn off the electrical equipments. Based on the conclusion, that the control and monitoring of electrical equipments are running well, with 3 outputs such as: lamp, air conditioning, and TV as announcement display. GPIO pins which are activated can send instructions appropriately, so that electrical devices can be controlled and monitored automatically.

Keywords: General Purpose Input Output (GPIO), Raspberry Pi, Web server, Electrical equipments

Design Of Electrical Equipments Control Using Web Server And Raspberry Pi In Telkom's Telematics School of Engineering University

Risa Farrid Christianti[1], Andika Agung[2], Eka Wahyudi[3]
[1,2,] Telkom's Telematics School of Engineering University
D.I. Panjaitan street no.128 Purwokerto
[1]risa@st3telkom.ac.id, [2]agung.leo22@gmail.com, [3]ekawahyudi@st3telkom.ac.id

ABSTRACT

The purpose of writing this paper is to find the solution how to control the use of electrical equipments daily, particularly in campus building, which so far is still done manually, which is spending much time and inefficient, using the Raspberry Pi (one of microcontroller types) that functions as the central of control and monitoring of electrical equipments in the Telkom's Telematics School of Engineering University, within one Single Board Computer. Raspberry Pi is one of microcontroller type that has many functions, one of them is as a web server. By using the GPIO (General Purpose Input Output) on the Raspberry Pi, every electrical equipments can be controlled and monitored, by means of communicating between electrical equipments with Raspberry Pi via TCP/IP and HTTP. Moreover used relays that serves as an electronic switch that will turn on or turn off the electrical equipments. Based on the conclusion, that the control and monitoring of electrical equipments are running well, with 3 outputs such as : lamp, air conditioning, and TV as announcement display. GPIO pins which are activated can send instructions appropriately, so that electrical devices can be controlled and monitored automatically .

Key Words : General Purpose Input Output (GPIO), Raspberry Pi, Web server, Electrical equipments.

I. INTRODUCTION

The advance of telecommunications in this globalization era provide enormous benefits in daily life. Proved by the sophisticated and modern equipment, which is able to assist people in working and communicating. This progress is also felt at one private university owned by Telkom or so-called Telkom's Telematics School of Engineering University in Purwokerto, especially in its operations in carrying out their activities, both in lectures and in administrative activities. But technological progress is still not fully utilized, so some work is still done manually and is quite exhausting and wasting time. With the increasing number of existing rooms in campus buildings, so the more utilization of electrical devices should be controlled. Controlling electrical devices still done manually, it means household employees have to visit each classroom and lecturer room to hit the switch of lamps, turn off the air conditioning and TV with its remote control, and others. So it can be concluded that the control of electrical equipments in the building of Telkom's Telematics School of Engineering University has not been effective and efficient.

From the problems mentioned above, the researchers conducted a research that can be used as a solution to overcome the ineffectiveness and inefficiency that occurs. By utilizing one of the telecommunication technology advances offered to the wireless network, or better known as Wi-Fi (Wireless Fidelity). Implementation of Wi-Fi using a web application, just need to put the application on a server and the application itself can be accessed anywhere, as long as the user can access its web server via a local wireless network. This local wireless network will be used by the researchers to control electrical equipments remotely. With the use of smartphone technology in this research, which will be connected to a web server and on a Single Board Computer (SBC) or what is now called the Raspberry pi. Web server that work on the Raspberry pi can turn off and turn on the electrical equipments using relays. Raspberry pi will replace human in general who is often turn on and turn off electrical equipments directly on the switch. Raspberry pi can be applied and used to facilitate in construct the efficiently smart building.

II. STATE OF THE ART

Zarza Sanchez, S. presents a modular system for monitoring and control of energy consumption. Specifically, the researchers demonstrate the applicability of the proposed system for monitoring and control of electrical energy in domestic installations or medium size offices. The entire system is integrated in a single platform and consists of different modules: one or several smart plug includes a wireless communication interface to connect to a WiFi network, and a centralized application server. The developed system allows real time monitoring of energy consumption, as well as the control and scheduling of remote switches, providing tools for optimal energy savings. Monitoring and control of this leads to a significant cost reduction and the sustainable management of energy resources that are beneficial to the environment. Results are also presented for the consumption of a typical scenario with five electrical outlets [1].

Related to this, Behan, M. stated about the usability of mobile devices that are not limited, and therefore, can be made the concept of the home environment (buildings) can be a smart future are controlled, monitored, or maintained by a mobile device. Therefore, the proposed Smart Home Point as an open source solution with an intelligent user interface that allows the user a simple low cost effectively control the sensors around it [2].

Aurilio, G. also stated that as the power transmission and distribution networks are gaining intelligence from the use of renewable energy and current measurements as well as the latest communication technologies, as well as utilities to be smart. In modern utilities, energy sources and energy efficiency in attendance must be guaranteed. Therefore, in order that the utility smart, it must be equipped with measurement and control networks to efficiently manage a wide range of energy sources and loads. In the paper Aurilio, low-cost solution for real-time energy management in smart grids is presented. As well as providing some of the electrical measuring devices, which continuously monitor the load connected to communicate with the Data Concentrator via Power Line Bus. Through a web server that implements the user can remotely control their consumption using a web browser. To prevent external attacks, software protection with a low computational cost, based on the Advanced Encryption Standard Code, implemented [3].

From these literature review above, it can be concluded that the control and monitoring of electricity utilization can be performed at a distance, by using a wireless communication network for connecting to WiFi networks, and mobile devices based on microcontroller. In this paper, the researchers propose a solution of controlling and monitoring the use of electrical devices in the building, using the Raspberry pi as a central

control and WiFi network as a communication media using PCs (laptops) and smartphones as a control device.

III. MODELING SYSTEM

Modeling system prepared in accordance with the function of each part of the system are made, as well as the position of the input and output of the system. There are two important things that can be considered, which makes the block diagram and system performance. At this stage prepared a working system that will be a reference in the manufacture of tools. It starts with determining the constituent parts of the system that includes the identification of the use of the component according to its function as an input, the control unit, and the system output.

The block diagram of the system hardware design, broadly divided into four main sections that can be shown in Figure 1.

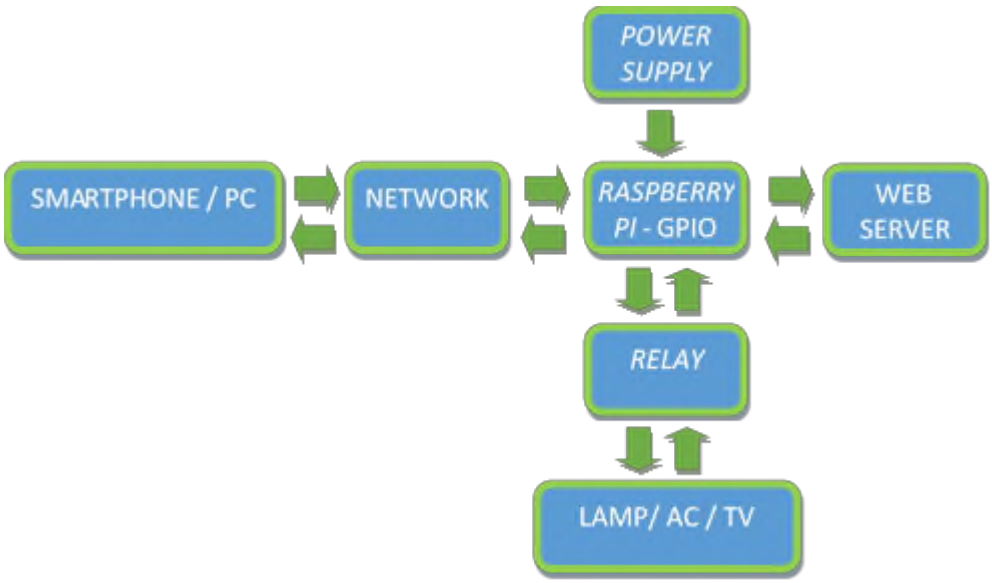

Figure 1. Block Diagram of system.

Four essential part of the system consists of : Power Supply as the primary voltage source, Raspberry pi as microcontroller, Input which consists of two devices, namely smartphone and computer that can be connected to the local network, and the output consists of a web interface server that indicates the state of the database stored on the raspberry pi and the actual conditions which can be shown by the condition of the relay is connected to the electrical equipments (eg. : lamp, air conditioning, and television as an announcement display), to monitor and control (turn on and off) electrical equipments that are used.

IV. DESIGN OF ELECTRICAL EQUIPMENTS CONTROL

In designing the hardware, there are some electronic components that are used. LED or Light Emitting Diode stands is one of the electronic components are commonly used to human life today. LED are now widely used, such as for the use of children's games lights, to traffic signs, the indicator light to the industrial electronic equipments, for emergency lighting, for TV, computer, speakers, external hard drives, projectors, LCD, and various other electronic devices as an indicator that the system is in the process of work, and

usually red or yellow [4]. In designing these tools, the LED will serve as indicators of the work of the relay is active and inactive. Relay is a switch that is controlled by the current. Relay has a low voltage coil which is wound on a core and nominal current that must be conect to the output or driver circuit. Currents used in the circuit is a DC current [5]. Relays are used in this design consists of two kinds, namely mechanical relays and SSR (Solid State Relay).

Raspberry Pi is a credit card-sized mini computer developed by the Raspberry Pi Foundation with the aim of stimulating learning the basics of computer programming or school. Along with its development, Raspberry Pi has now not only be used for education, but also widely used in electronic devices such as homemade automation, web servers and computer clusters. Raspberry Pi has a system similar to a cell phone, the system on chip (SoC). System on Chip consists of ARM1176JZF0-S processor with a clock speed of 700 MHz, 512 MB RAM and a graphics processor (GPU) Video Core IV. Raspberry Pi has connectors commonly found on computers in general, such as 2 USB ports, video output (composite and HDMI), audio output and input Ethernet (LAN) to connect to the network and internet. For hard drives, Raspberry Pi using a 4GB SD Card with the LINUX operating system. Rapberry Pi requires a DC power input of 5V via micro USB. Raspberry Pi has a 2 x 13-pin General Purpose Input Output (GPIO) to connect with other electronic components. Figure 2 shows the board of the Raspberry Pi as well as a description of its components.

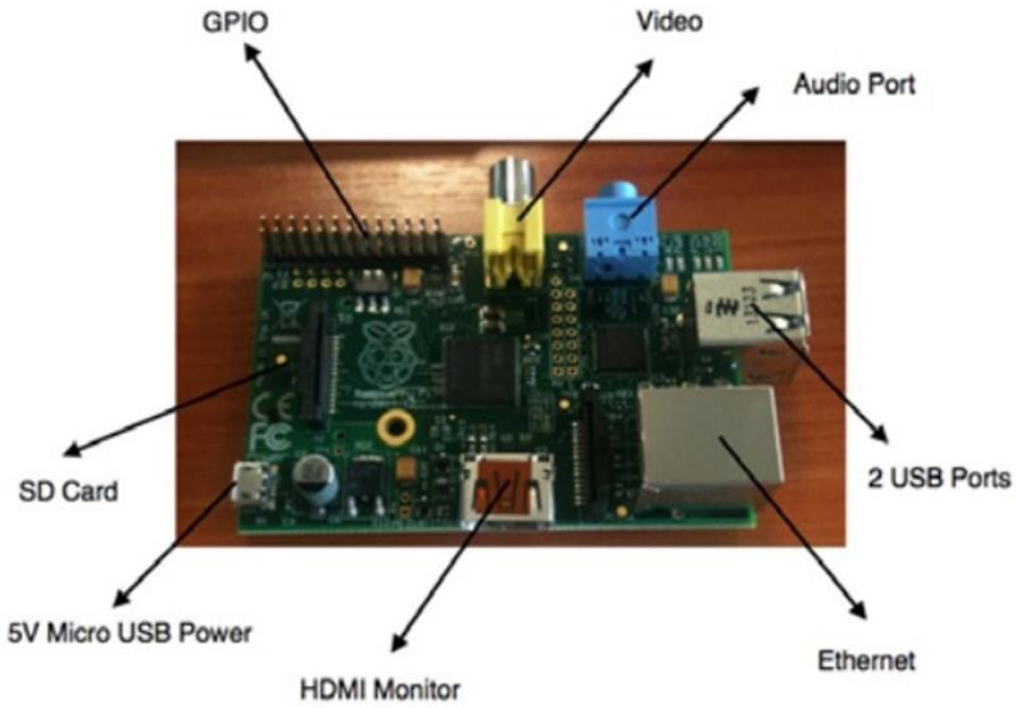

Figure 2. ***Raspberry Pi Board.***

Raspberry Pi has an operating system that is open source. So any system used on Raspbery Pi is to be free, and also free to be developed into a better operating system again. In Table 1 shows the specifications of Raspberry Pi.

Table 1. Specifications of *Raspberry Pi*

Component	Information
CPU	*700 MHz ARM1176JZF-S core (ARM6 Family)*
Memori	*512 MB / 256 MB (shared with GPU)*
USB Ports	*2 (via integrated USB hub)*
Onboard Storage	*SD / MMC / SDIO card slot*
Onboard Network	*10 / 100 Ethernet (RJ45)*
Low-Level Peripherals	*8 x GPIO, UART, I^2C bus, SPI bus with two chip selects, +3.3 V, +5 V, ground.*
Power Source	*5 volt via MicroUSB or GPIO header*
Planned Operating Systems	*Debian GNU / Linux, Fedora, Arch Linux ARM, RISC OS, OpenWRT.*

At Raspberry Pi there are General Purpose Input Output (GPIO) pins, namely generic pin on the chip that can be controlled or programmed via software configured as either an input pin or output pin [6].

The transistor is a diode with two connections (junctions). That Connections form the PNP and NPN transistors. The ends of consecutive terminals called the emitter, base, and collector [7]. In this design, the transistor function as an ON/OFF switch that is part of a relay driver circuit.

The diode is the type of vacuum tube that has two electrodes. The diode tube was first created by a British scientist named Sir JA Fleming (1849-1945) in 1904. In the diode, the plate is placed in a position to surround the cathode while the heater is inserted into the cathode. The electrons in the cathode is heated by the heater will move from the cathode to the plate [8]. In this design, diode functioning as a rectifier and be part of the relay driver circuit.

While the compilers of the software consists of XAMPP, MySQL, and PHP. Many users have difficulty installing the Apache web server and getting in trouble if adding a MySQL database, PHP and Perl. XAMPP is one installation package of Apache, PHP and MySQL instant that can be used to assist in the installation of these three products. XAMPP is a free software, which supports many operating systems, is a compilation of some programs. Its function is as a stand-alone server (localhost), which consists of the Apache HTTP Server, MySQL database, and language interpreter written in PHP and Perl programming languages. The program is available in the General Public License (GNU) and free, an easy to use web server that can serve dynamic web page views [9].

MySQL is one of the many Relational Database Management System (RDMS), which is distributed for free under the GNU Public License (GPU). So everyone is easy to get and free to use MySQL, the limit should not be used as a derivative product that is closed source or recommended. MySQL is a derivative of one of the main concepts in the

database for a long time, the Structured Query Languange (SQL). SQL itself is a concept of operation of the database, especially for election or selection and data entry, which allows the operation of the data is done easily automatically. This will facilitate the database when the user wants to reuse the existing database. Its open source community and support millions of users on the Internet, make MySQL as database software that is widely used. Not only that, its ability to be used on a variety of operating systems also makes MySQL as database software choice, but it also provided a mailing list and a special homepage that provide tutorials and comprehensive documentation. Basically, the reliability of a database system DBMS can be determined bunch optimazer see how his work in the process of SQL commands, either created by the user or by the application programs. MySQL is a database server that can be said to be superior to the other database server in the query [10].

PHP (Personal Home Page) is a programming language that allows web developers to create dynamic web applications quickly. PHP stands for "PHP: Hypertext Preprocessor". PHP was written and first introduced around 1994 by Rasmus Lerdorf through its website to find anyone who has access to its online summary. PHP is a scripting language that is relatively new and is freely available and still allow it to be developed further. PHP can be integrated (embedded) into a web server, or it can act as a CGI (Common Gateway Interface) separate. Characteristics of the most superior and most powerful in PHP is a database integration layer (database integration layer). PHP is supported databases: Oracle, ADABAS-D, Sybase, FilePro, mySQL, Velocis, MySQL, Informix, Solid, dBase, ODBC, Unix dbm, and PostgreSQL. The main purpose of the use of the language is to allow web developers to write dynamic web pages quickly [11].

The design is continued by making flow chart of the software working. The working principle of software for controlling electrical equipments using a web server and a raspberry pi in Telkom's Telematics School of Engineering University shown in figure 3.

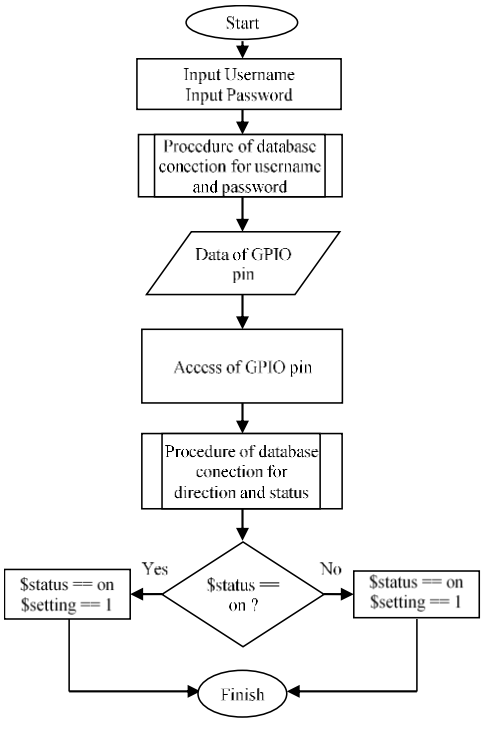

Figure 3. *Flow Chart* of software working.

Figure 3 shows the initial access while using the application run on a web server control via smartphone. On the display the user autentication initial conditions are used as security on the web server. User autentication will adjust to a database that has been created and stored on the raspberry pi. raspberry pi has its own storage area that can be used as supporting data storage device with a capacity large enough. In the database there are also data storage GPIO pins used to control at each relay that is connected to an electrical equipments. Database of GPIO pins that can be used to control a relay by reading the database prior condition, condition or status of the pins to be used. Condition or status in the database is very important, to avoid errors during the control relay is supposed to be the living become dead. Readings corresponding database, will run the program in accordance with instructions on the raspberry pi will be shown the results to changes in conditions of controlled electrical equipments and changing the color of the button on the interface of a web server connected to the database.

After passing through the login process, raspberry pi can be run using a text-based operating systems and Graphics User Interface (GUI). Furthermore, after enabling GUI base, can easily turn on or set to a local network that is connected in order to get a random IP. On the condition of all GPIO pins have been active and the program has been incorporated in the raspberry pi, raspberry pi will further enable the web server prearranged. Web server is enabled to function as a control each GPIO pin that already has a database on the raspberry pi. Web server will be a control media on a smartphone browser that can be controlled remotely.

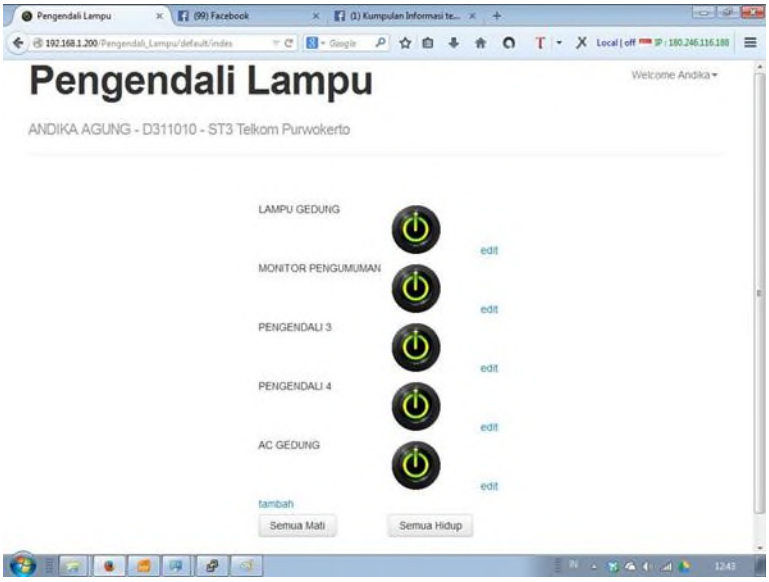

Figure 4. Display on the PC/*Smartphone*.

Figure 4 shows the display on a PC/Laptop/Smartphone connected to the system controller in electrical equipments of Telkom's Telematics School of Engineering University. Through this system, the user can control electrical devices in several rooms in the building.

V. ANALYSIS

The analysis begins with testing tools and evaluate performance of all parts of a tool that supports this control system. Testing is done by inserting a Raspberry pi listing pilot program to turn the LED on pin certain conditions, to instruct the LED lights up for a second and a second die. Listing program used in the trial is shown in Figure 5.

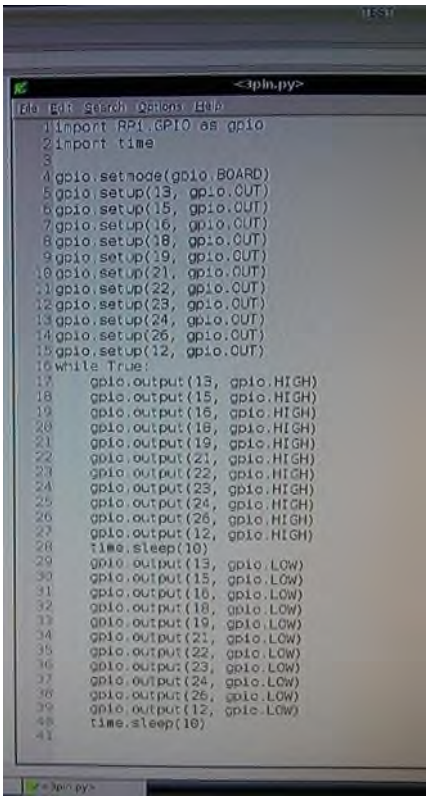

Figure 5. ***Listing of*** **Trial Program**

In figure 5, shown examples of program listings are made on programming Pyton, to conduct trials of the device as well as learning basic programming Pyton. In the program listing, are imported rpi.gpio as GPIO, which shows the initial order to enable the existing GPIO module. Import time shows that the orders are made to function in a unit time. GPIO mode with multiple Board showed the expected future output pin can function and be controlled. To turn the LEDs used commands gpio.output (16 gpio.HIGH). Gpio.output command can be interpreted as a command which is used to set the conditions for what will be displayed on the digital pins, while the condition has a high logic 1 is used as a condition of the digital pins are switched. However, these conditions depend on the circuit making up the device to be used. There are two conditions for turning on and off digital pins, the first meaning is active high digital pins are connected on the components used will turn on when the voltage fed and die in a state of tension flowed. Both are active low, this condition is the opposite of that where the conditions high active components connected to the digital LED will light on when the voltage is not fed and would die if fed voltage. In tests performed using this LED use LEDs on the board itself, so that the conditions used are active high. The resulting condition is a flashing LED will turn on. From this test it can be concluded that the Raspberry pi is in good condition or not broken so it can be used as the controlling electrical equipments.

Testing is done by inserting a relay module program Pyton the blink of program listings. There are two relay outputs are used, the mechanical relay and relay SSR, so there are two output pins are used to connect between the Raspberry pi and the relay. relay testing using Pyton program or blink program is shown in Figure 6 and 7.

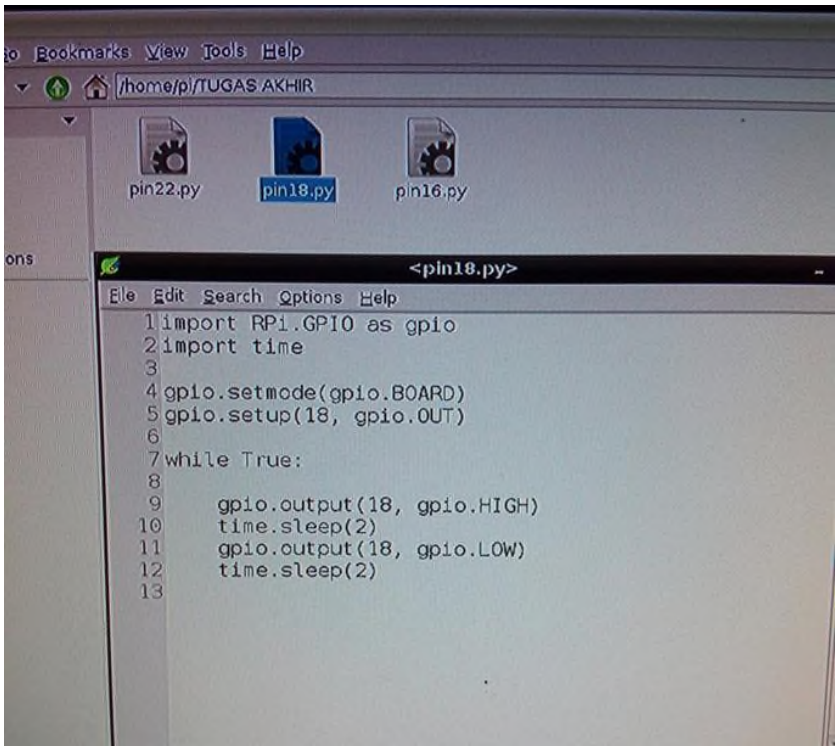

Figure 6. Listing of GPIO pin 18

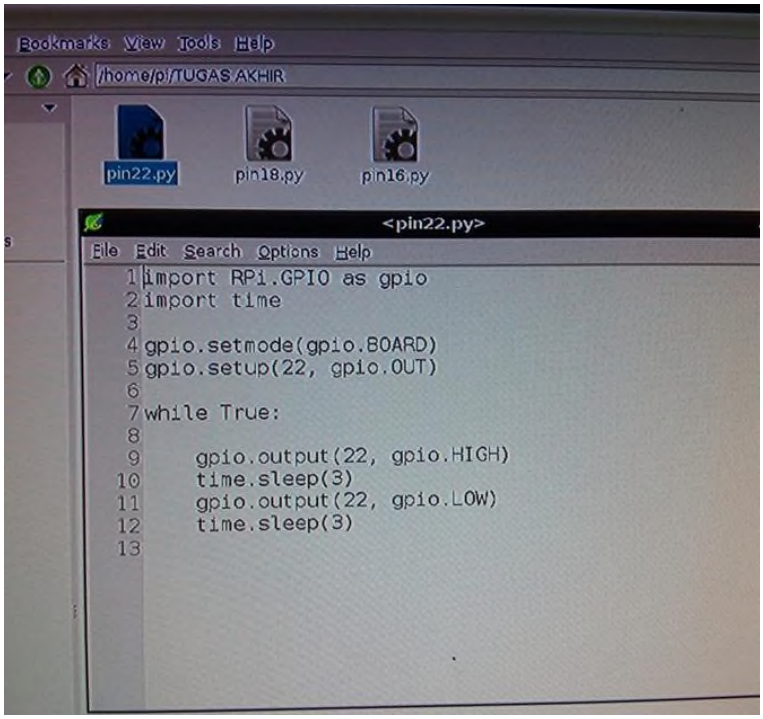

Figure 7. Listing of GPIO pin 22

From the total testing tool, it can be concluded that the Electrical Control System can work as expected, although in this research the output which is controlled electrical equipments are still limited (only one lamp, one air conditioning and one TV). The main controls are on the Raspberry pi is not perfect without any operating system. Required operating system has been planted in the memory card. Linux operating system is open source. Each of the GPIO pins can be controlled through a web server that is already installed on the operating system, this is one of the advantages that can be provided by a system that is designed as a remote control of electrical equipments.

VI. CONCLUSION AND SUGGESTIONS

From the test results and analysis, researchers can conclude several things, are :

1. Raspberry Pi GPIO pins have 3.3V logic output and input voltage should not be higher than 3.3V. By utilizing the GPIO pins raspberry pi, the electrical equipments of the building can be monitored and controlled.
2. Web-based interface in it now added with the fasility which user can be registered by the admin user name, user password and access rights to control and monitor the electrical equipments.
3. Raspberry pi has clocked over the facility to increase the clock speed of 700MHz become 1000MHz, so it can help improve the performance of the user or the operating system and applications that run on it. Controlling electrical equipments can also work under conditions not get a direct voltage of PLN, as the device is still able to work long and light up only by utilizing a portable power supply or the so-called power bank or UPS.
4. This electrical equipments control system can solve problems that occur in Telkom's Telematics School of Engineering University. Control of electrical equipments can be done using a smartphone and without having to do it manually and see if it lights on or off.

Researchers added a suggestion that can be used as an idea to develop and increase the performance of this research, while the suggestions are as follows :

1. It is expected that access to the web server is not only within the scope of a LAN, but also within the scope of the WAN via the internet.
2. More of use the facilities of the GPIO pins, such as communication with other electrical equipments. As utilizing the RX TX facility.
3. Controlling electrical equipments, can be developed using any IP camera and control device are recorded every time the controlling user, as well as how long the control, the fees charged and have billing.
4. More of developed in control and utilization of applications on raspberry pi to control other electrical equipments with the web.

REFERENCES

[1] Zarza Sanchez, S. (2014, February). "Monitoring and Remote Control of Energy Consumption by WiFi Networks," in Multi-Conference on Systems, Signals & Devices (SSD), 2014 11th International. [Online] Available : http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=6808798&url=http%3A%2F

%2Fieeexplore.ieee.org%2Fxpls%2Fabs_all.jsp%3Farnumber%3D6808798 [28th October 2014].

[2] Behan, M. (2013, September). "Open IP-based Sustainable Concept of Intelligent House Controlled by Mobile Devices," in Intelligent Signal Processing (WISP), 2013 IEEE 8th International Symposium on. Available : http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=6657494&url=http%3A%2F%2Fieeexplore.ieee.org%2Fxpls%2Fabs_all.jsp%3Farnumber%3D6657494 [28th October 2014].

[3] Aurilio, G. (2014, May). "A Low Cost Smart Meter Network For A Smart Utility", in Instrumentation and Measurement Technology Conference (I2MTC) Proceedings, 2014 IEEE International. Available : http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=6860772&url=http%3A%2F%2Fieeexplore.ieee.org%2Fxpls%2Fabs_all.jsp%3Farnumber%3D6860772 [28th October 2014].

[4] Budiharto, Widodo. Firmansyah, Sigit, "Elektronika Digital Dan Mikroprosesor," First Edition, Jakarta, Indonesia, Erlangga, 2009.

[5] Kho, Dickson, (2013, October), "Prinsip Kerja Relay Beserta Fungsi dan Simbolnya," [Online] Available : http://www.produksielektronik.com/2013/10/cara-prinsip-kerja-relay-fungsi-simbol-relay/

[6] Fredy, Christian Naa. Viridi, Sparisoma. "Raspberry pi Sebagai Solusi Murah Untuk Pendidikan Pemrograman Dasar Dan Dasar-Dasar Kendali," in Phisic Contribution Seminary, Bandung, Desember, 2013, page 61-66.

[7] Monk, Simon., (2013, April). "Adafruit's Raspberry pi Lesson 4.GPIO , Adafruit Learning System," Dokumen PDF. [Online]. https://learn.adafruit.com/downloads/%20pdf/adafruits-raspberry-pi-lesson-4-gpio-setup.pdf.lar?hl=id&q=Design+Of+Electrical+Equipments+Control+Using+Web+Server+And+Raspberry+Pi&btnG=

[8] Paul B. Zbar and Albert P. Malvino, "Basic Electronics: A Text – Lab Manual," Tata McGraw-Hil Publisher, 7th editon, 2001.

[9] Wagito, "Jaringan Komputer Teori dan Implementasi Berbasis Linux," First Edition, Yogyakarta, Indonesia, Erlangga, 2011.

[10] Nugroho, Bunafit, "Aplikasi Pemrograman Web Dinamis Dengan PHP dan MySQL," First Edition, Jakarta, Indonesia, Andi Publisher, 2011.

[11] S Sing Tel, "PHP (Personal Home Page)," Dokumen PDF. [Online] http://222.124.203.59/files/disk1/509/jbptunikompp-gdl-stephanipu-25413-2-bab2.pdf [28th October 2014].

STT Telematika TELKOM

Telkom Indonesia

SURAT TUGAS

NO. STT Tel. *998* /SDM-000/KET-00/XI/2014

Yang bertanda tangan dibawah ini:

Nama : Hafif Rachmat Isna, ST.,MBA.
Jabatan : Ketua STT Telematika Telkom

Menugaskan kepada :

No	Nama	Jabatan
1	Risa Farrid Christianti, ST.,MT.	Kaur LPPM/Dosen
2	Dwi Januarita AK, ST	Kaur Kerjasama/Dosen

Untuk melaksanakan tugas mengikuti Seminar "PIKSI International Conference On Knowledge and Sciences 2014" pada:

Hari/ Tgl : Selasa – rabu, 18 – 19 November 2014
Waktu : Pukul 08.00 s.d selesai
Tempat : Sabuga ITB
Bandung

Demikian untuk dilaksanakan dan laporkan hasilnya.

Purwokerto, 17 November 2014
Ketua STT Telematika Telkom

STT Telematika TELKOM

Hafif Rachmat Isna, ST.,MBA.

PIKSI INTERNATIONAL CONFERENCE ON KNOWLEDGE AND SCIENCES 2014

IN COOPERATION WITH:

POLITEKNIK MALAYSIA SEBERANG PERAI

TWINTECH MALAYSIA

Certificate
Sertifikat

Awarded to / Diberikan kepada : *Risa Farrid Christianti*

as / Sebagai :

Paper Presenter

DESIGN OF ELECTRICAL EQUIPMENTS CONTROL USING WEB SERVER AND RASPBERRY PI IN HIGH SCHOOL OF TELKOM TELEMATICS TECHNOLOGY

at the event / pada Acara :

PIKSI INTERNATIONAL CONFERENCE ON KNOWLEDGE AND SCIENCES 2014
18 - 19 November 2014 Bandung, Indonesia

Chair person,
Ketua Panitia,

Yudhy Purwanto, SS., M.Hum., MM.
1st PICKS 2014

Director,
Direktur,

DR. H. K. Prihartono AH., Drs., S.Sos., MM.
Politeknik Piksi Ganesha